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[SHAPE * MERGEFORMAT] REGION WATER

October 31, 2019

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RE: Civil Action No. 1:15-cv-00291-WWC: City Beautiful H2O Program Plan –Response to October 2019 EPA Technical Information Requests

To Plaintiffs, Civil Action No. 1:15-cv-00291-WWC:

Capital Region Water (CRW) and its legal and technical consultants met with representatives of EPA and PA-DEP on October 17, 2019. Technical questions previously submitted by EPA to CRW were discussed. At various points during the meeting, the EPA technical consultant requested that additional information be provided from CRW, and the desired supplementary information was described. It was subsequently agreed that the technical responses would be submitted to EPA and DEP by October 31. A meeting between CRW, EPA, and PA-DEP will be scheduled to review and discuss the CRW responses, provide additional clarification, and discuss next steps. This letter contains the requested additional technical information.

1.0 Existing Condition CSO Discharge Statistics

EPA Request: For existing condition typical year precipitation, provide a table of the overflow volumes and durations for the 15 largest storm events for each of the CSO outfalls within the CRW system.

CRW Response: The requested information is provided within attached **Tables 1 and 2**. Table 1 provides the CSO discharge volumes for each CSO outfall and storm event. Table 2 provides the CSO discharge durations. The 15 largest storm events were ranked by their corresponding total system-wide CSO discharge volumes. The discharge volumes and durations were color coded with conditional formatting to facilitate interpretation of the results and efficient identification of the largest and smallest values.

Commented [TR1]: Data provided is as requested

CRW's combined sewer system is made up of 59 CSO catchments/regulators. Many of the regulator structures have small tributary areas, and the smaller catchment size leads to less attenuation of peak flows from trunk sewers and leads to short duration peak flows from a wide range of rainfall depths and intensities. Under existing conditions, frequent overflows occur due to small control orifice openings and Brown & Brown flow mechanisms, located within the CSO regulator structures, that activate to limit surcharging of the interceptor and prevent exceedance of the hydraulic capacities of the downstream pump stations and advanced wastewater treatment facility. Some CSO catchments are very large, which accounts for the large CSO volumes they produce.

Commented [TR2]: Agree – this is the reason that highly localized CSO abatement measures such as on-street storage or inline storage should be considered. Based upon the information in Table 1, it appears that on-street or inline storage is feasible for all but one of the CSO outfalls – CSO-48, where flow rates/volumes suggest that a localized ActiFlo/ CL_2 facility would be the most cost-effective CAS abatement measure. PG analysis of street grades sent separately show there are a large number of locations suitable for on-street and inline storage.

2.0 Flow and Precipitation Monitoring

EPA Request: Provide a description of the CRW flow and precipitation monitoring program that has been conducted to date.

CRW Response: Beginning in August 2014, CRW has been conducting flow and precipitation monitoring at select locations within its service area. The monitoring strategy and specific monitoring locations were defined in the approved *Initial Flow Metering and Monitoring Program Plan* dated July 2013, and subsequently amended. The approved CRW monitoring program consists of the following six categories of monitoring activities. Each are described below. They are also described in Sections 3.3 and 3.4 of the CBH2OPP. The intent of the monitoring program was to quantify and characterize dry and wet weather flow and support calibration of the hydrologic and hydrologic (H/H) model which was the primary tool for determining CSO volumes, frequencies and durations and the development and evaluation of alternative control strategies and facilities.

Commented [TR3]: Program as described in the bullet points following should be adequate for hydraulic model development/calibration/validation

- Precipitation monitoring –ongoing
- Interceptor monitoring, including points of connection with suburban systems – ongoing
- Receiving water boundary condition monitoring – ongoing
- CSO regulator structure monitoring –completed, 1-year duration
- Separate sanitary sewershed monitoring –completed, 1-year duration
- Daily visual CSO detection monitoring of every regulator structure - ongoing

2.1 Precipitation Monitoring

The CRW monitoring program includes a long-term rain gauge network consisting of 8 telemetered tipping bucket rain gauges located throughout the CRW service area. Additional precipitation data is also collected from the Capital City Airport gauge and the Harrisburg International Airport gauge.

The locations of these gauges are shown in attached **Figure 1**. Precipitation data are collected at 5-minute intervals. The gauges have solar power cells, and supplemental electricity is provided at each site to support heating elements during the winter season. The gauge network is maintained and supported by a professional monitoring service provider.

Commented [TR4]: Figure 1 shows that there are an adequate number of rain gauges across Harrisburg and that they are appropriately positioned ot collect rainfall date suitable for hydraulic model calibration/validation and for interpretation of flow meter data.

Commented [TR5]: Who is the provider?

To better characterize the natural spatial variability of precipitation volumes and patterns between the gauge locations, the digital precipitation data are integrated into a Gauge Adjusted Radar Rainfall (GARR) system supported by a GARR consultant. In the production of GARR, the raw radar reflectivity is bias corrected through comparison with the rain gauge accumulations. The digital data are reported with a 1-km by 1-km pixel grid resolution in 5-minute reporting intervals. The GARR pixel precipitation is transformed to sewershed precipitation and input into the hydrologic/hydraulic (H/H) model.

Commented [TR6]: This will further enhance the suitability of rainfall data for use in hydraulic model calibration / validation.

Commented [TR7]: Best for modeling

2.2 Interceptor Monitoring

The CRW monitoring program includes a long-term network of 13 telemetered interceptor flow monitoring sites located along the six major sewer conveyance systems in the City of Harrisburg. Three of the monitoring sites are located along the Front Street Interceptor, five of the monitoring sites are located along the Paxton Creek Interceptor, one monitor is located along the Paxton Creek Relief Interceptor, one monitor is located along the Asylum Run Interceptor, two meters are located along the Spring Creek Interceptor, and one monitoring site is located along the Hemlock Street Interceptor. The locations of these monitoring sites are provided in attached **Figure 2**. The 13 interceptor monitoring sites include four sites at the points of connection between the suburban community collection systems and the CRW interceptor system. Nearly all the separate sanitary flow from the suburban communities is continuously monitored at these four sites, (M9, M13, M167, and M32) located at the upstream ends of the interceptors. The monitoring network is maintained and supported by a professional monitoring service provider.

Commented [TR8]: The layout of the flow meters shown in Figure 2 appears appropriate.

Commented [TR9]: Best way to assure these and other meters described in the flowing paragraphs remain functional over the long term – who is the provider?

2.3 Receiving Water Boundary Condition Monitoring

Water surface elevations along the Susquehanna River are continuously monitored by permanent USGS gauge 01570500, located on City Island, and recorded in hourly increments. The CRW monitoring program includes a long-term network of 4 telemetered stream depth metering sites located along Paxton Creek. The digital water surface elevation data are collected in 5-minute intervals and loaded into the hydraulic model as boundary conditions for the CSO regulator structures and outfall pipes. The locations of these stream elevation gauges are shown in attached **Figure 3**. The Paxton Creek stream monitoring network is maintained and supported by a professional monitoring service provider.

Commented [TR10]: Not particularly important

2.4 CSO Regulator Structure Monitoring

To quantify and characterize dry and wet weather flow and CSO discharges from combined sewershed areas within the City of Harrisburg, monitoring sites were established at 13 CSO regulator structures. The monitoring data were used to calibrate the H/H model of the CRW collection system. The selection process for these 13 critical and representative sites is documented in the 2013 *Initial Flow Metering and Monitoring Program Plan*, as amended, and was intended to monitor 25% of the 59 CSO in the CRW collection system. The selection criteria are summarized below. The locations of these monitoring sites and their tributary sewershed areas are shown in attached **Figure 4**.

Commented [TR11]: OK – for characterization, not practical to monitor all CSOs

- On-site inspections verify that hydraulic, site accessibility and traffic control conditions are suitable for successful depth, velocity, and flow monitoring
- The cumulative tributary areas of the sites include a large portion of CRW combined service area
- The sites are representative of the hydrologic conditions throughout the Harrisburg collection system
- A representative range of overflow frequencies is monitored
- Monitoring is conducted at each predominant type of CSO regulator structure

The monitoring duration for these sites was 12 months plus a 4-week equipment settling-in period. The CSO regulator structure monitoring network was maintained and supported by a professional monitoring service provider. Telemetered area/velocity meters with redundant depth measurement were installed along the influent sewer immediately upstream of each regulator structure and redundant depth sensors were installed at the diversion weir. Influent flow, overflow frequency and overflow duration for each storm event were directly monitored in 5-minute increments. Overflow volumes were estimated using the monitored depths over the diversion weirs. Overflow and capture volumes are calculated more precisely using the H/H model.

2.5 Separate Sanitary Trunk Sewer Monitoring

To quantify and characterize dry and wet weather flow from City sewershed areas served by separate sanitary collection systems, a network of 7 telemetered monitoring sites was established. The total tributary sewershed area to these trunk sewer monitoring sites is approximately 59% of the total separate sanitary sewershed area of the CRW system. The locations of these monitoring sites, along with the tributary sewershed areas, are depicted in attached **Figure 5**. At these sites, area/velocity meters with redundant depth sensing continuously monitor and record data at 5- minute intervals. The monitoring duration for these sites was 12 months plus a 4-week equipment settling-in period. The separate sanitary trunk sewer monitoring network was maintained and supported by a professional monitoring service provider.

Commented [TR12]: The layout of the flow meters shown in Figure 5 appears appropriate

The EPA Sanitary Sewer Overflow Analysis Program (SSOAP) analysis toolbox was used to analyze precipitation and flow data and deconstruct the total monitored flow into three categories: base wastewater flow, ground water infiltration, and rainfall dependent infiltration and inflow (RDII). The calculated volume of RDII for each storm was divided by the corresponding volume of rainfall over the sewershed areas and expressed as a percentage, or R-value. The SSOAP program was subsequently used to distribute the calculated RDII volumes and develop a series of three triangular unit hydrographs to represent the fast, medium, and slow responses of the sewershed collection systems to each of the monitored storms. Selected individual storm hydrographs were averaged together on a monthly basis to represent seasonal variability and these monthly unit hydrograph values were input into the H/H model and used to quantify flows from the suburban community systems and separate sewershed areas of the City.

Commented [TR13]: No issues – this is the standard approach

2.6 Daily Visual CSO Detection Monitoring

Every CRW regulator structure is inspected on a daily basis by CRW crews as part of their routine operation and maintenance procedures. A wooden block is placed on each diversion dam crest to detect overflow activity. The daily visual inspections include checking the diversion dam to see if CSO activity is occurring or as recently taken place. These visual checks and any maintenance activities are documented using the CityWorks system and entered into a database. These documented visual observations are used to validate the CSO discharge frequencies calculated by the H/H model.

Commented [TR14]: PG still has concerns that all of these structures can be inspected by a single crew in a single day. If CRW sticks with "human SCADA", PG suggests CRW inspect all structures every other day or even every third day during dry weather and then send out a second or third CRW to inspect after rainfall days. A far better approach would be to install Smart-Cover-type level sensors in the regulator structures to detect overflow events. These sensors could also provide information on the duration of overflows. And, if properly set up, these sensors could also provide a reasonable measurement of overflow volume.

3.0 TSS as a Pollutant of Concern

EPA Request: Identify TSS as a pollutant of concern for the Susquehanna River.

CRW Response: EPA has stated that TSS should be identified as a pollutant of concern for the Susquehanna River, because TSS is associated with CSOs and because CRW has a waste load allocation for TSS in the Chesapeake Bay TMDL. While we do not agree with that rationale, CRW will agree to treat TSS as a pollutant of concern for the Susquehanna River, for purposes of the LTCP alternatives analysis.

Commented [TR15]: EPA request accepted by CRW

4.0 Computation of Percent Capture

EPA Request: Provide a detailed description of the mathematics for computing percent capture. It is understood that the wastewater flow from the separate sanitary sewer collection systems of the suburban communities was not included in the CSO capture computations.

CRW Response: CRW used the following methodology to calculate the percent capture documented in Section 8.4 of the CBH2OPP.

Step 1: Extract Flows at each CSO Regulator from H&H Simulations of Typical Year Precipitation

The percent capture of combined sewer flows is based on three simulated flow hydrographs at each regulator structure:

- QRUNOFF = Hydrograph of flow from the combined sewer catchment entering the CSO regulator.
- QCSO = Hydrograph of flow discharging from the combined sewer overflow (CSO) pipe. QCSO can be negative and the model calculation accounts for any river intrusion through the outfall pipe that may occur.
- QAWTF = Hydrograph of flow in the pipe connecting the regulator structure to the interceptor sewer and ultimately to the advanced wastewater treatment facility (AWTF). QAWTF can be negative and the model calculation accounts for any backflow from the interceptor up into the regulator structure that may occur.

Commented [TR16]: Where has this happened? What rainfall frequency/duration that causes this? And, what is the associated volume?

Commented [TR17]: Same questions as immediately above

Dry and wet weather flows discharged directly to the interceptor from suburban community separate sanitary collection systems and CRW's separate sanitary sewershed areas (i.e., sewers that do not discharge through a combined sewer regulator structure) are excluded from this calculation.

Commented [TR18]: Very important

Step 2: Define Start and End of Each Wet Weather Event

In the CBH2OPP, the start of a wet weather event is defined as when there is rainfall and when QAWTF (i.e., the flow in the pipe connecting the regulator structure to the interceptor) increases by more than 5 percent of the dry weather flow, which is comprised of the base wastewater flow (BWWF) plus the groundwater infiltration (GWI); or when QCSO is greater than zero. The overflow ends when CSO flow ceases or the connector pipe flow decreases below 105% of the dry weather flow. The BWWF is represented in the H/H model with diurnal patterns. GWI is represented with seasonal variations. At each time step, flow is compared to the dry weather flow for that regulator for the corresponding month and hour. In the CRW H/H model, rainfall events are separated by a 6-hour interevent time.

Commented [TR19]: Agree – this is very important in the calculation process

Step 3: Calculate Capture Volume (VCAPTURE) and Overflow Volume (VCSO) for Each Event

Capture calculations are performed using the volume represented by the portion of the QAWTF and QCSO hydrographs generated by CRW's H/H model simulations during each storm event for historical and/or typical year precipitation. For existing conditions, captured volume (VCAPTURE) is equal to the volume of combined sewer flow that is sent to the AWTF during a wet weather event (VAWTF) via the connector pipe.

Commented [TR20]: Figure 3-2 of the CRW LTCP (attached) shows that several separate sewer areas are tributary to the combined sewer system and then to the interceptor – **does the percent capture calculation process exclude these separate sewer area flows from the combined sewer capture volume?**

Step 4. Calculate Percent Capture at each Regulator

Percent capture (PCAPTURE) is calculated as the ratio of the captured volume (VCAPTURE) to runoff volume (VRUNOFF), where (VRUNOFF) is the sum of captured volume (VCAPTURE) and volume overflowed to receiving waters (VCSO)):

PCAPTURE = 100 *VCAPTURE/VRUNOFF

Step 5. Determine Systemwide Overflow Capture

The capture calculations are performed at each regulator. System-wide overflow volume is calculated as the aggregation of the combined sewer overflow volume from each regulator, subtotaled for each of the three combined interceptors. There are no overflows or volume lost from the CRW system, as simulated, at any point other than a designated CSO outfall.

Alternatives Analysis Capture Calculation Methodology

Capture calculations for the alternatives that have been analyzed in the CBH2OPP (i.e. Local Control Strategies: Decentralized Stormwater Infrastructure, Satellite Storage and Treatment; System-wide Control Strategies: Enhanced Conveyance and Increased AWTF Capacity and Deep Tunnel Storage and Conveyance) are performed using the existing condition model capture values as the basis. The approach described below assumes that the overflow volume reduction, as compared to the existing values, is due to implementation of the alternatives. In alternatives with CSO controls in place, captured volume includes volume sent to the AWTF (i.e. by enlarging conveyance pipes and opening up regulator structures) and the volume prevented from reaching the Combined Sewer System (CSS) by source controls (i.e. re-directed, infiltrated, evaporated, and/or transpired runoff volume). Percent capture is calculated as the ratio of the captured volume to the sum of captured volume and volume overflowed to receiving waters.

Please contact me directly to discuss any question or concerns you may have. Sincerely yours,

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